

# Comparisons between AIRS tropospheric water vapor and a trajectory model

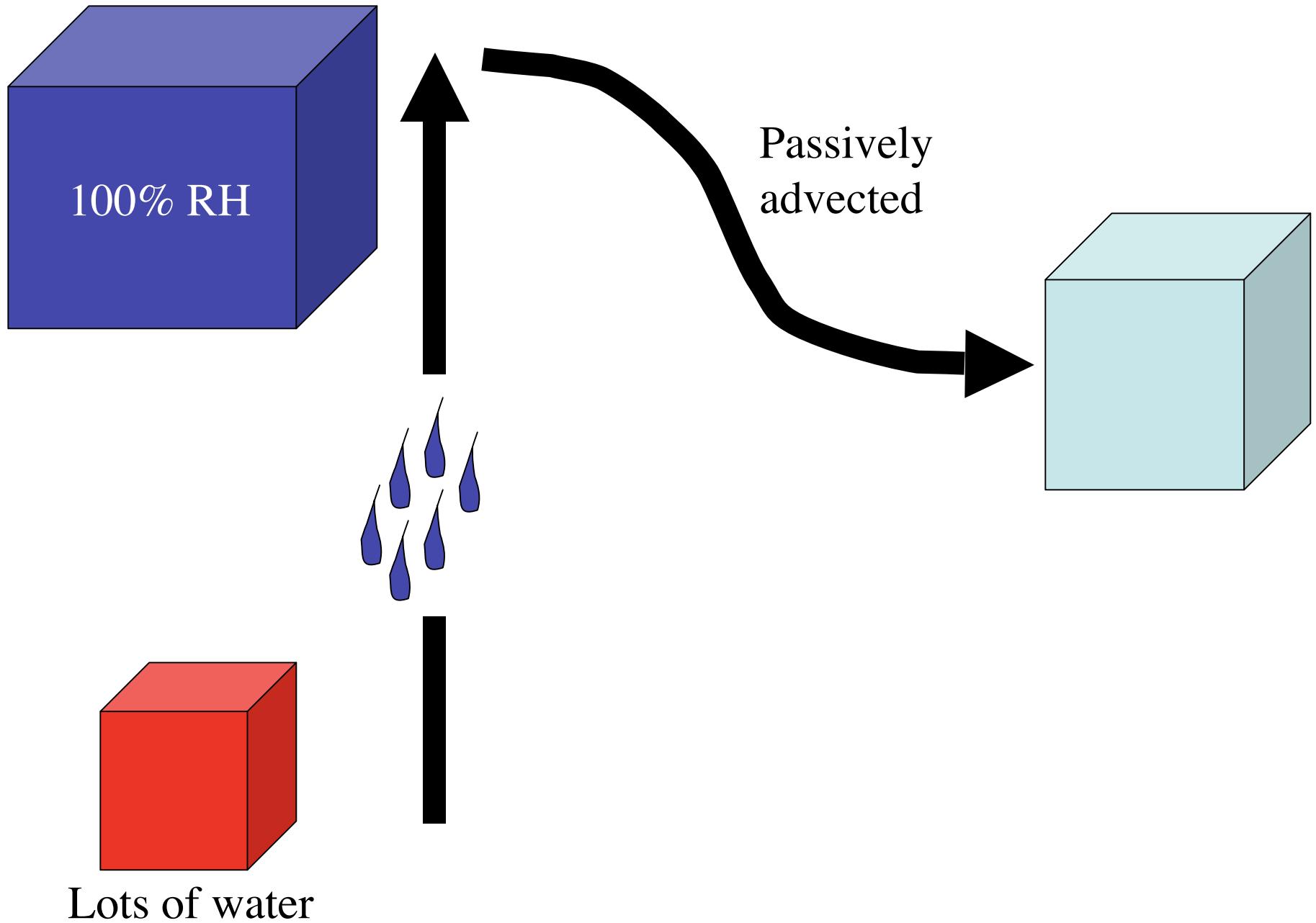
A. E. Dessler  
Department of Atmospheric Sciences  
Texas A&M University



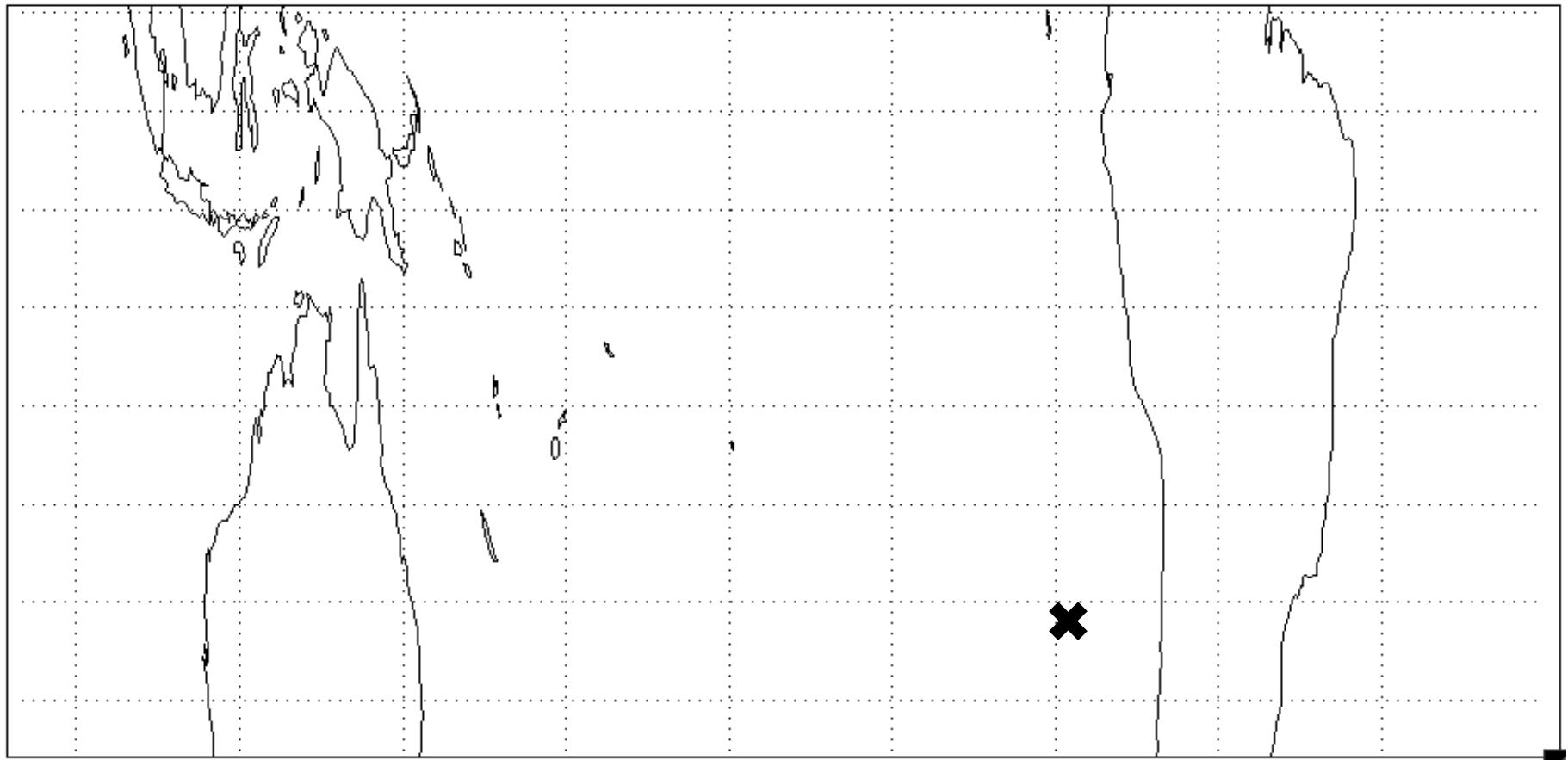
# Water Vapor

- Abundance determined by mix of
  - large-scale transport,
  - small-scale processes occurring around convection,
  - microphysical processes

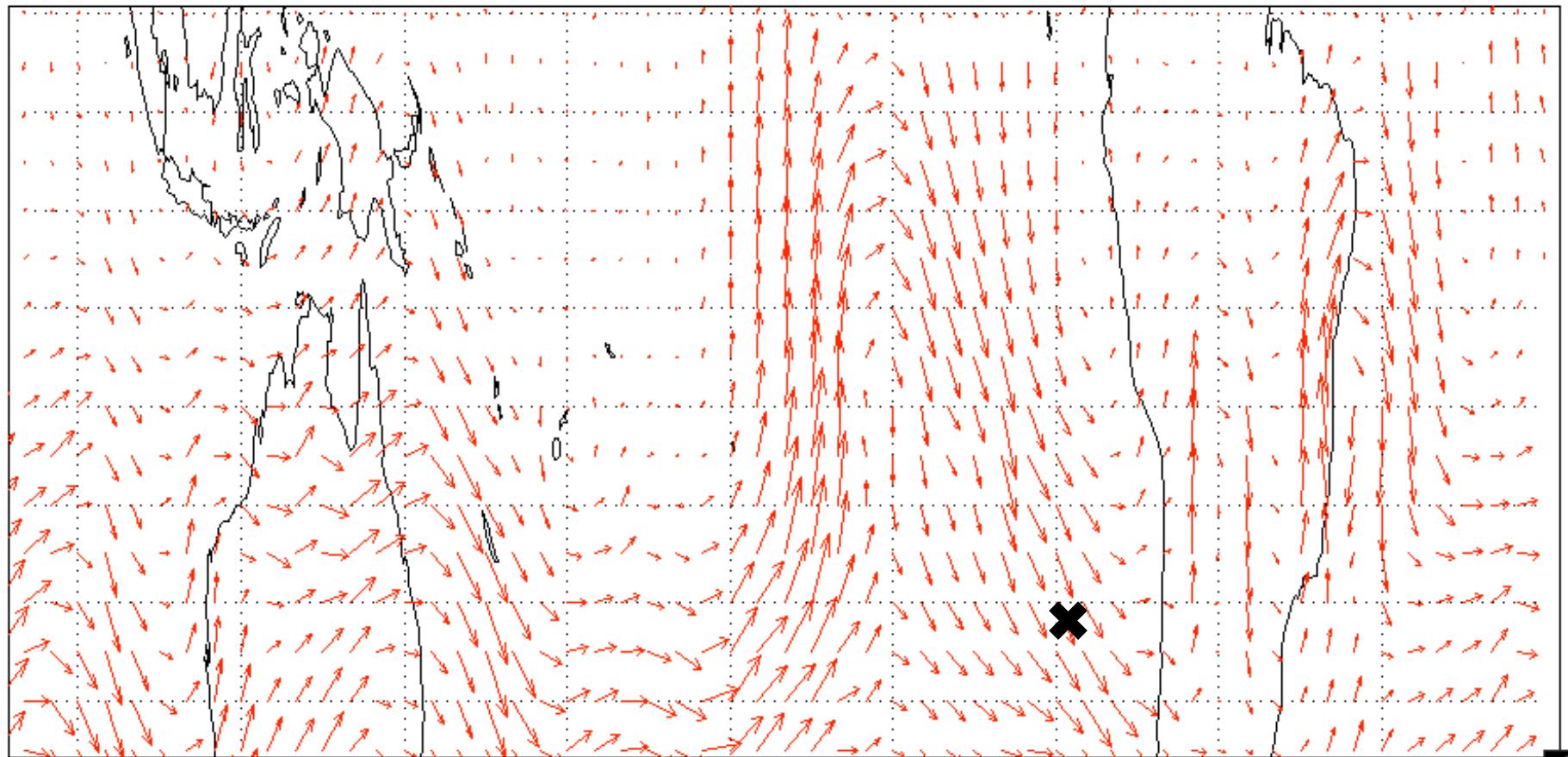




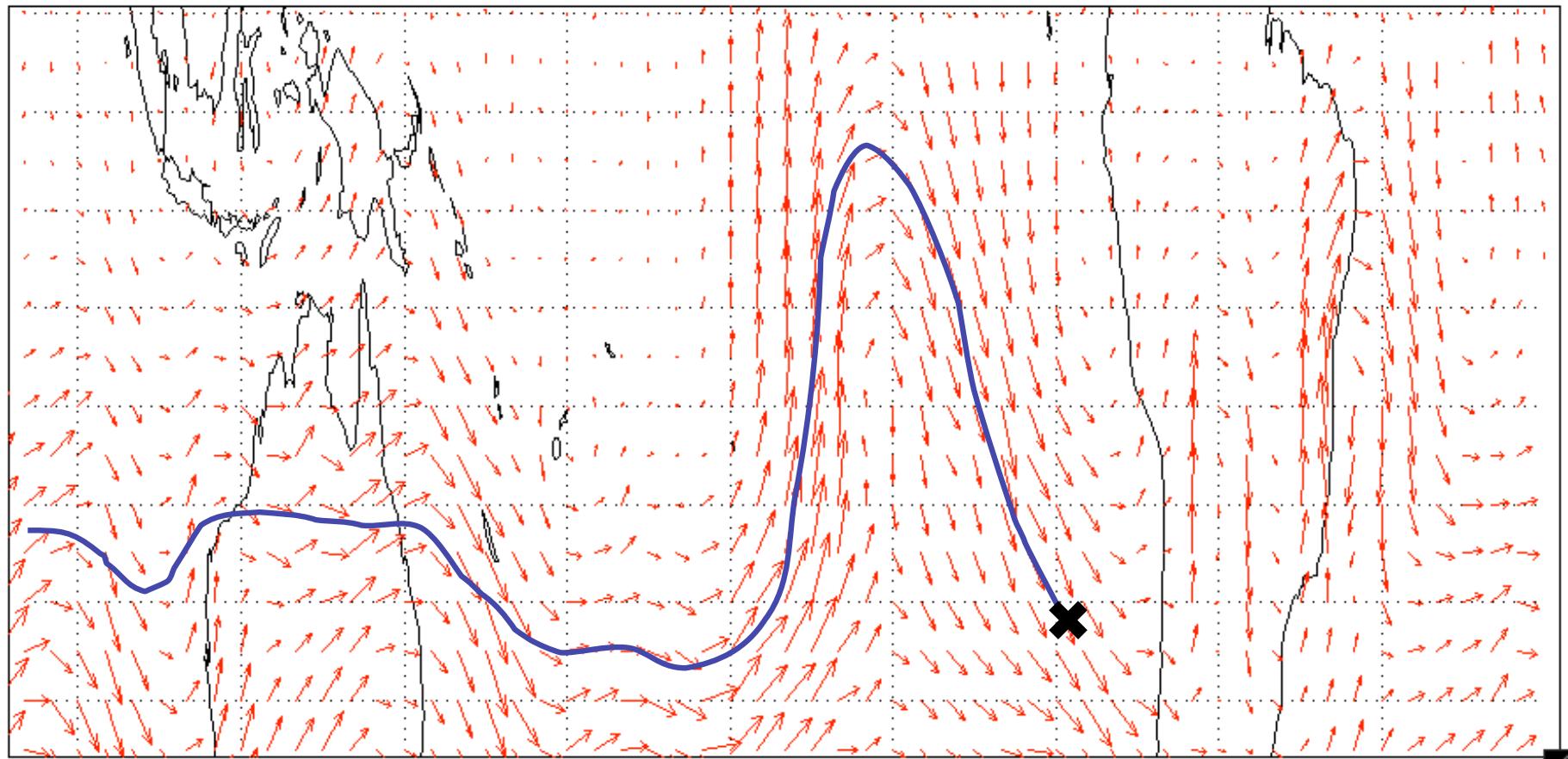
# What is a trajectory calculation?



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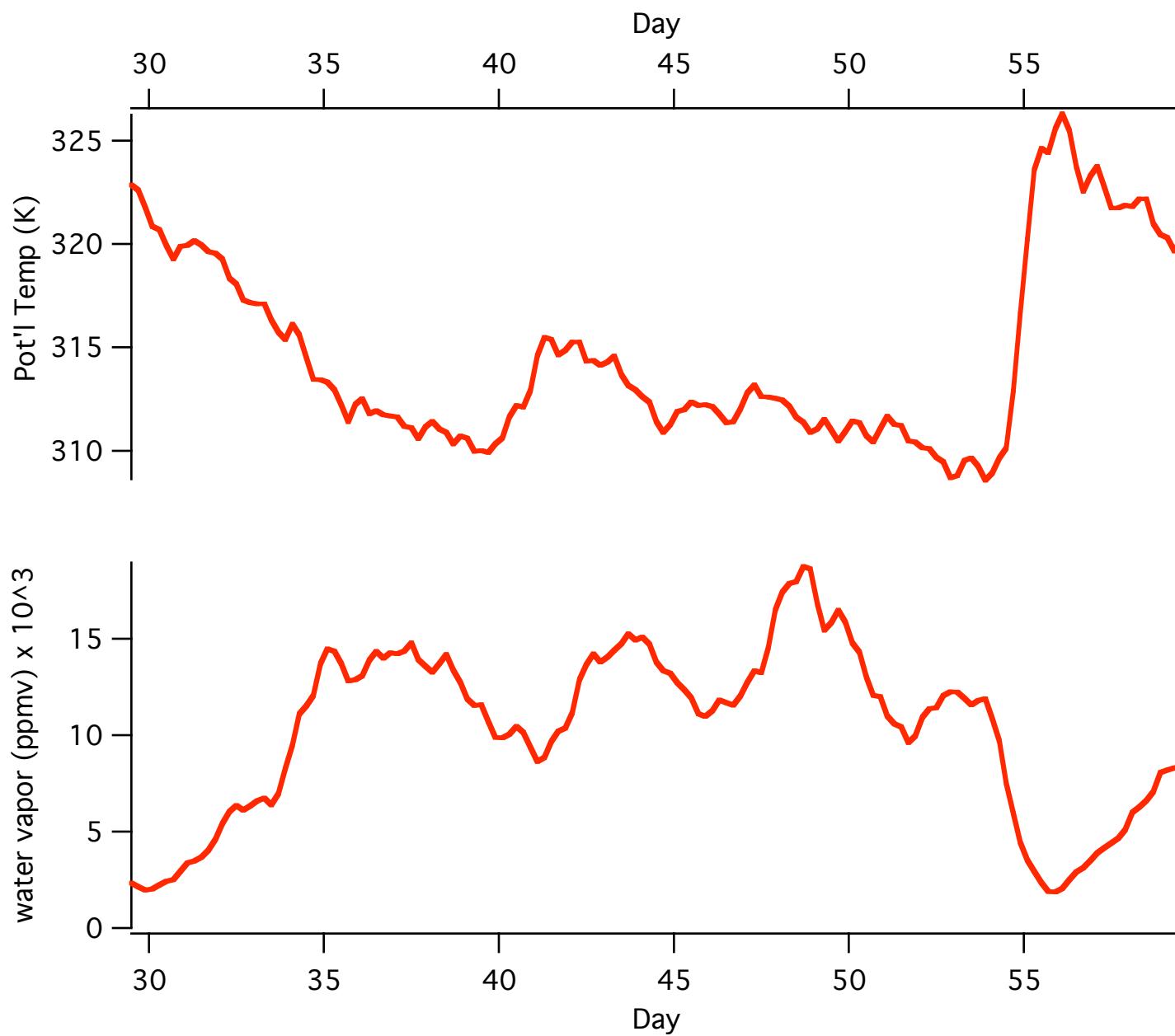
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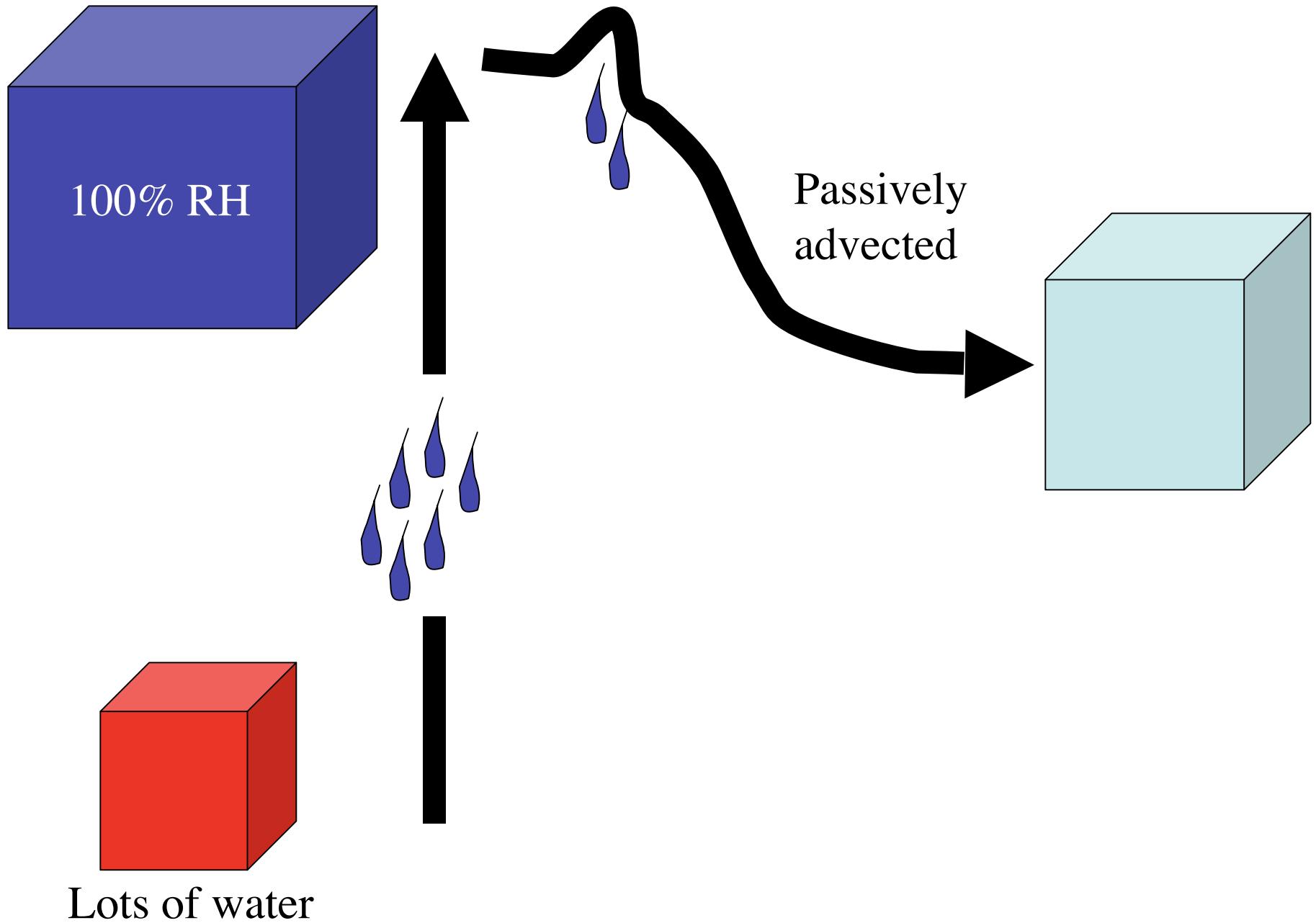


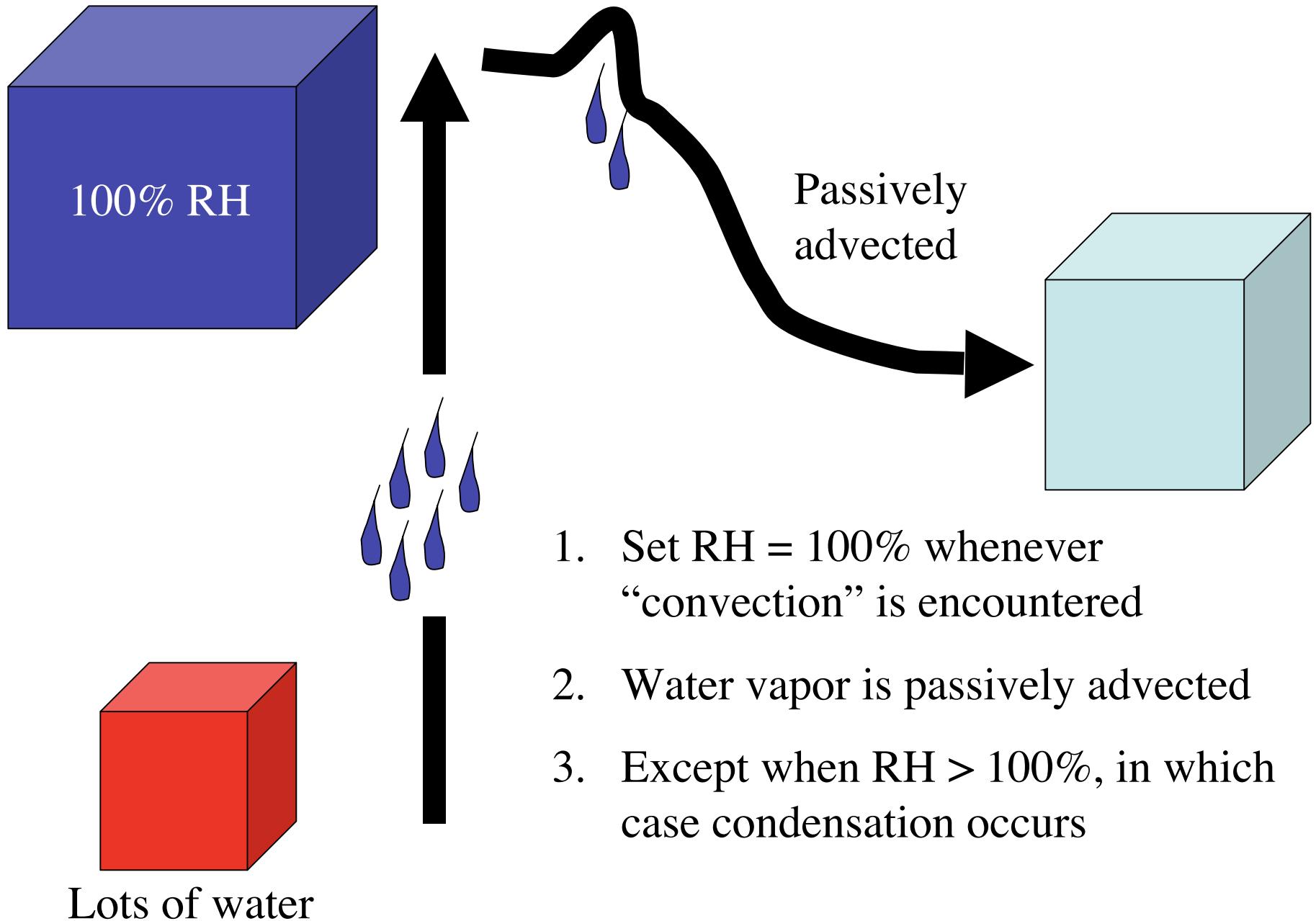
History of parcel's lat, lon, T, p for the past 30 days

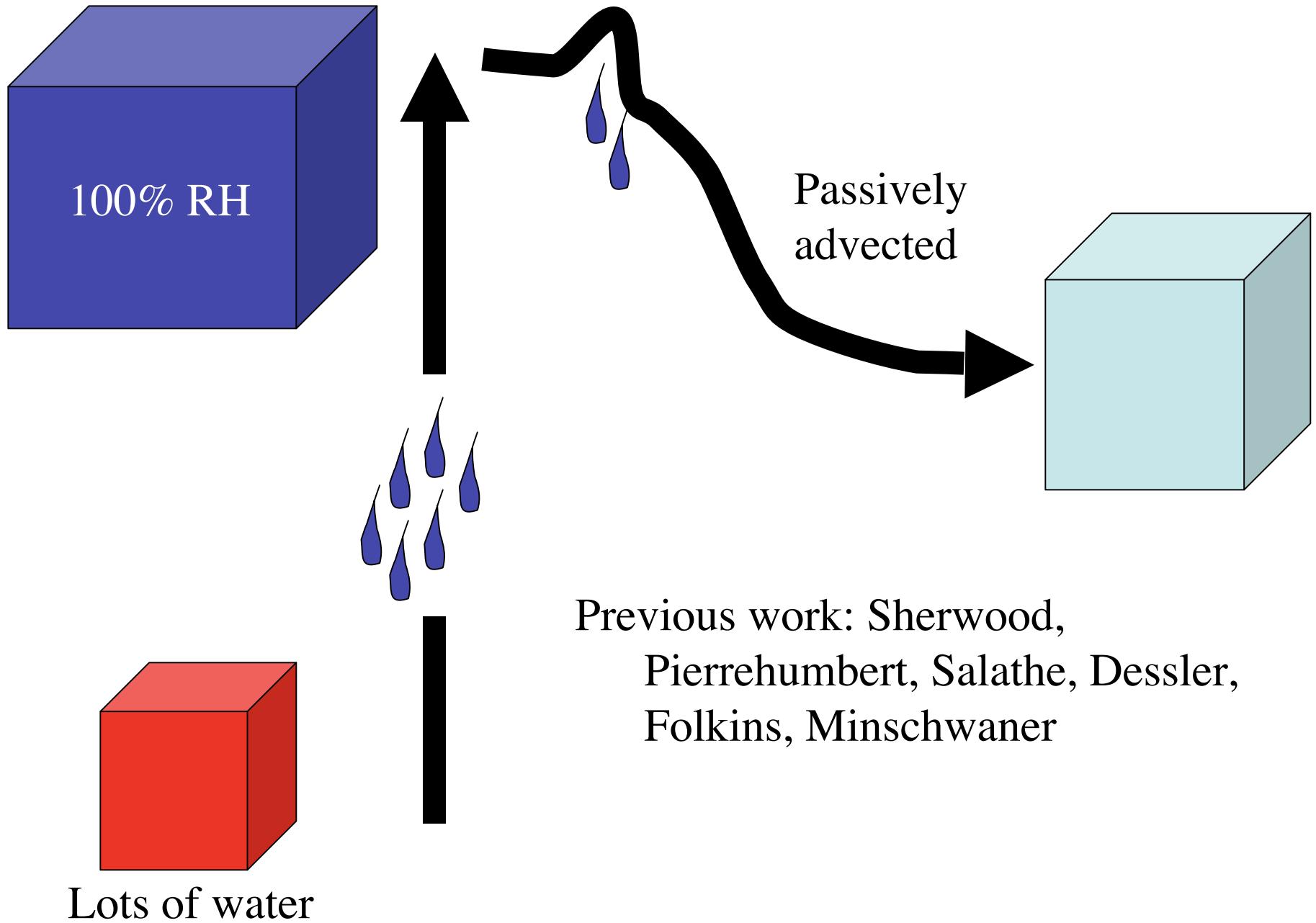


Parcel 2010 on 3/1/03: final location 24.5°S, 149.5°W

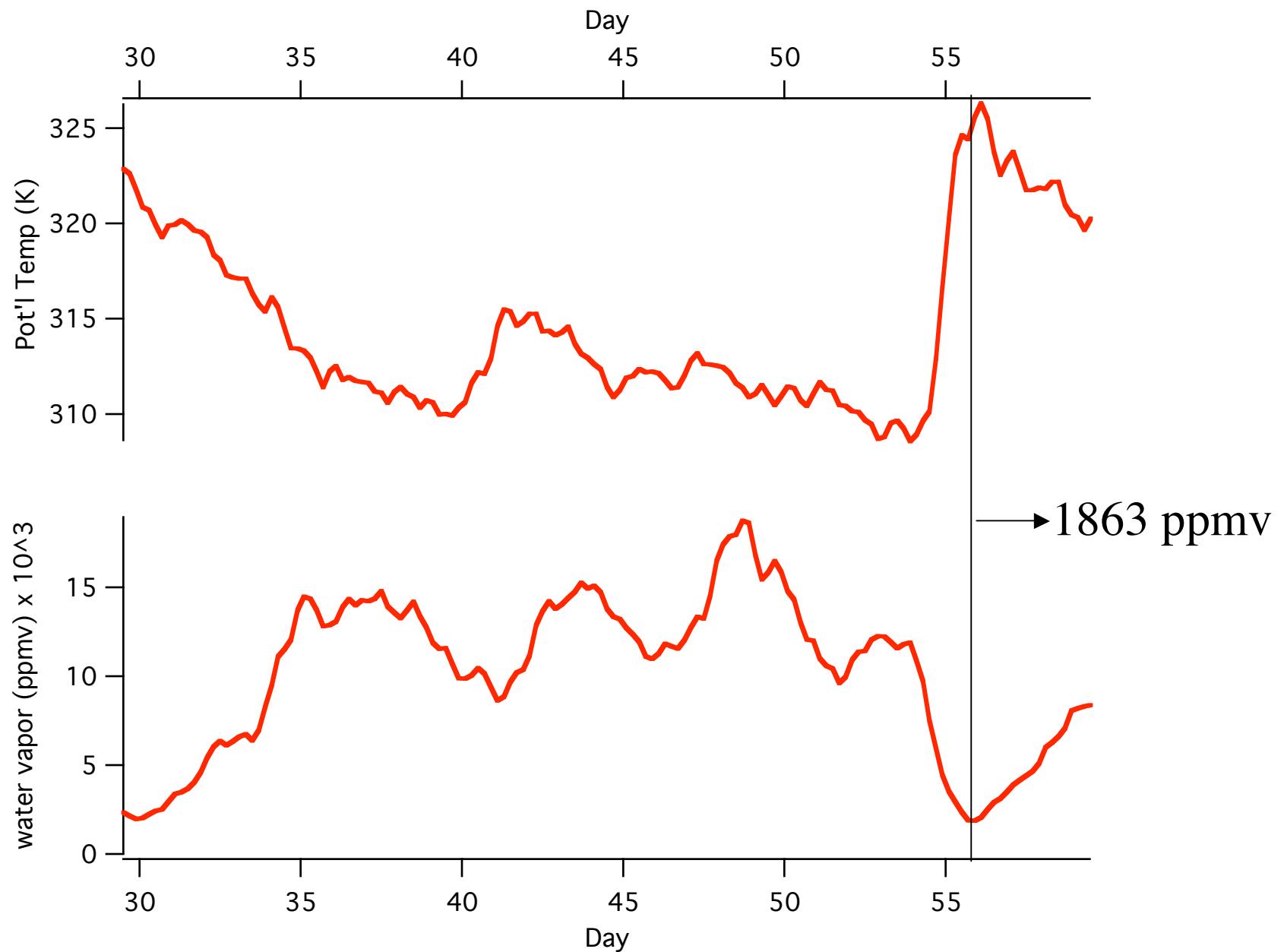






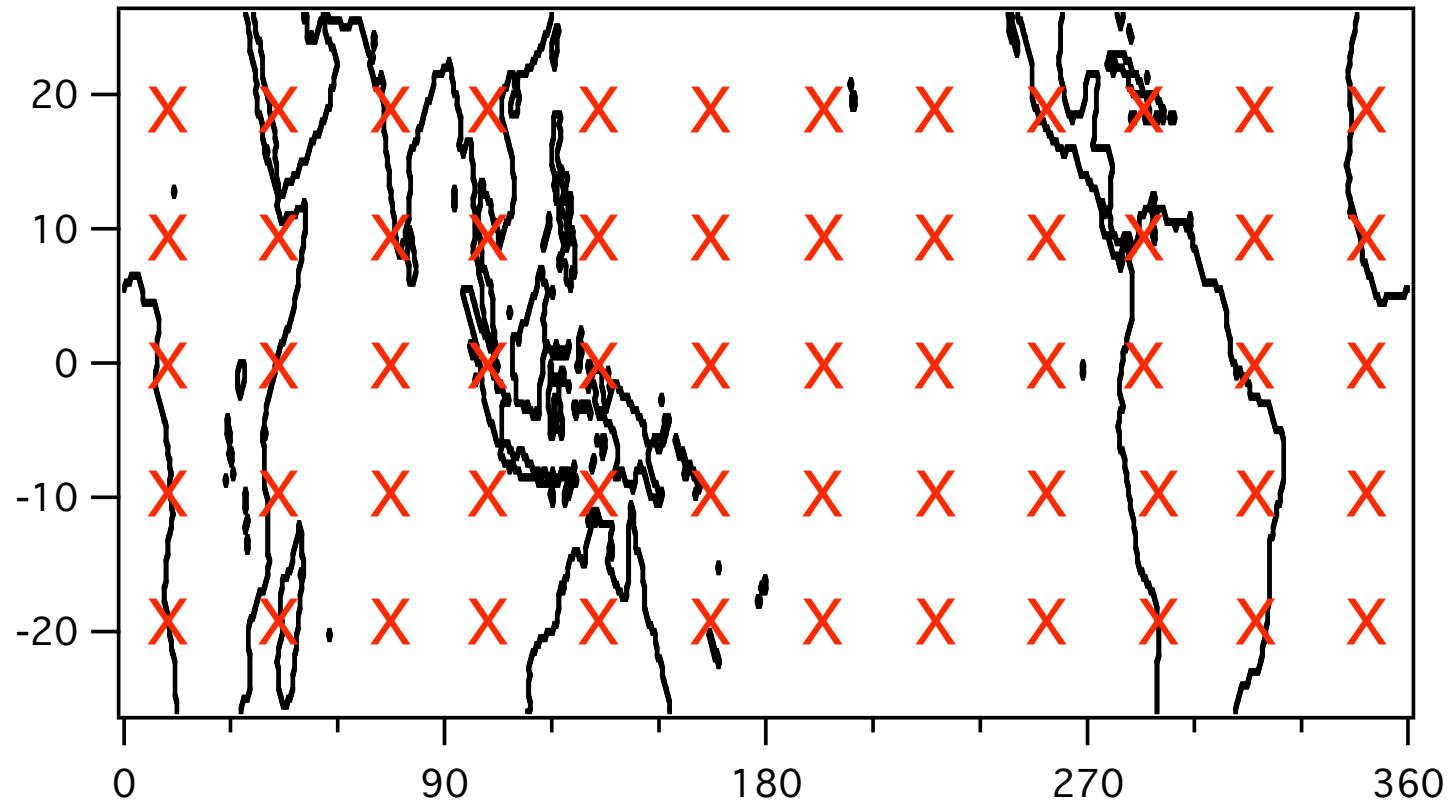


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- Model “convection” comes from average rising motion in NCEP reanalysis
- Model “microphysics” is simplest possible: hard RH limit of 100%



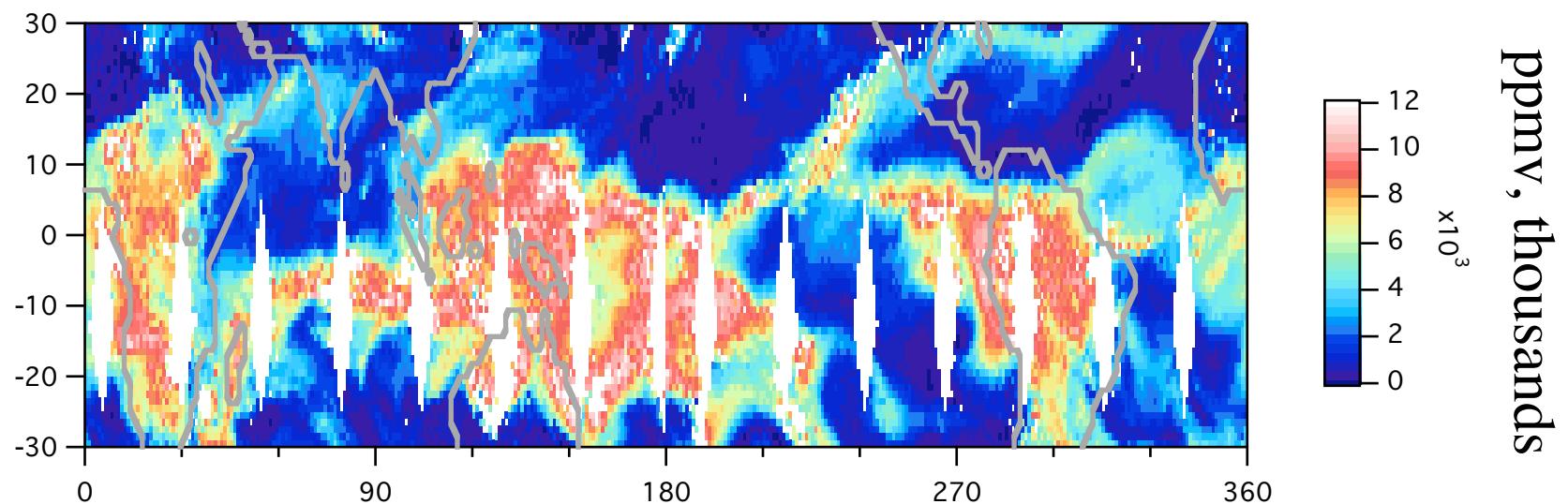


Regular grid of parcels on a pressure surface,  $1^\circ \times 1^\circ$  resolution

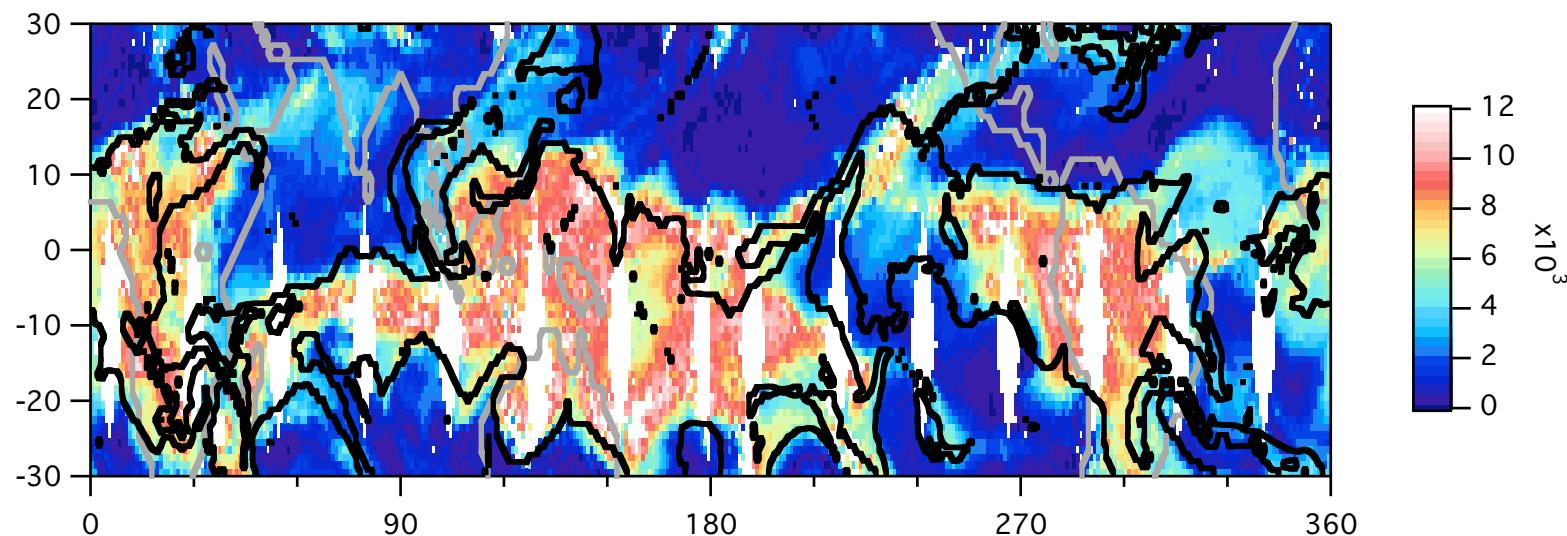
Compare annual average with annual avg. V4 L3 AIRS



# AIRS data: 3/1/2003 @ 600-500 hPa



AIRS data: 3/1/2003 @ 600-500 hPa  
Traj model: 547 hPa

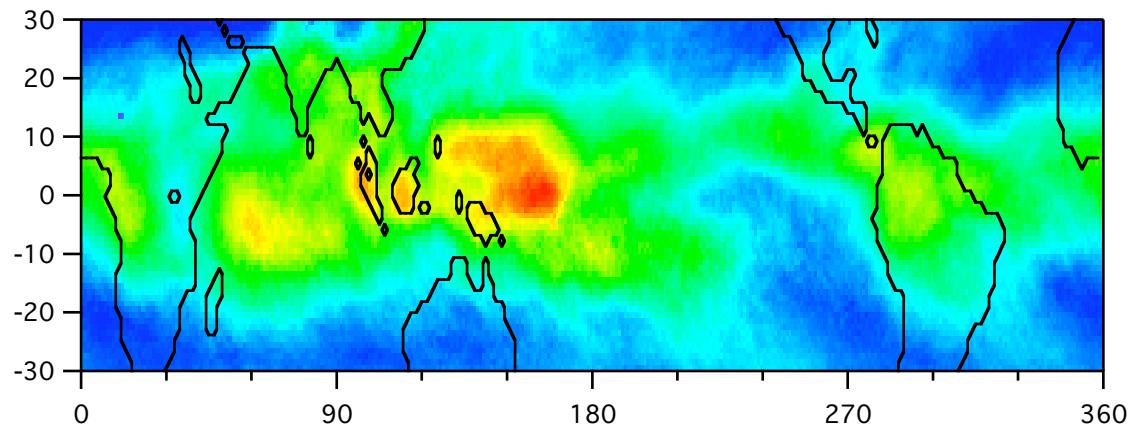


Black contour = 4000 ppmv

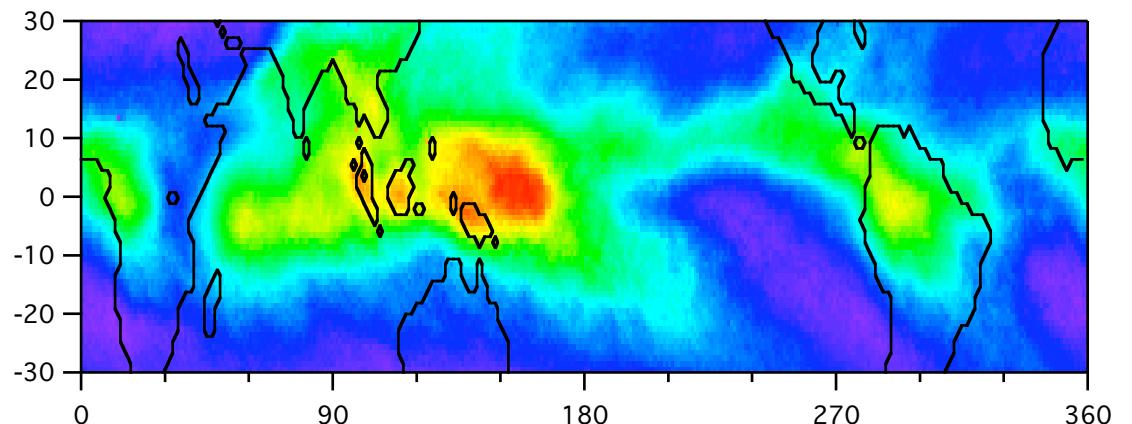


Average:  
3/1/03-2/28/04

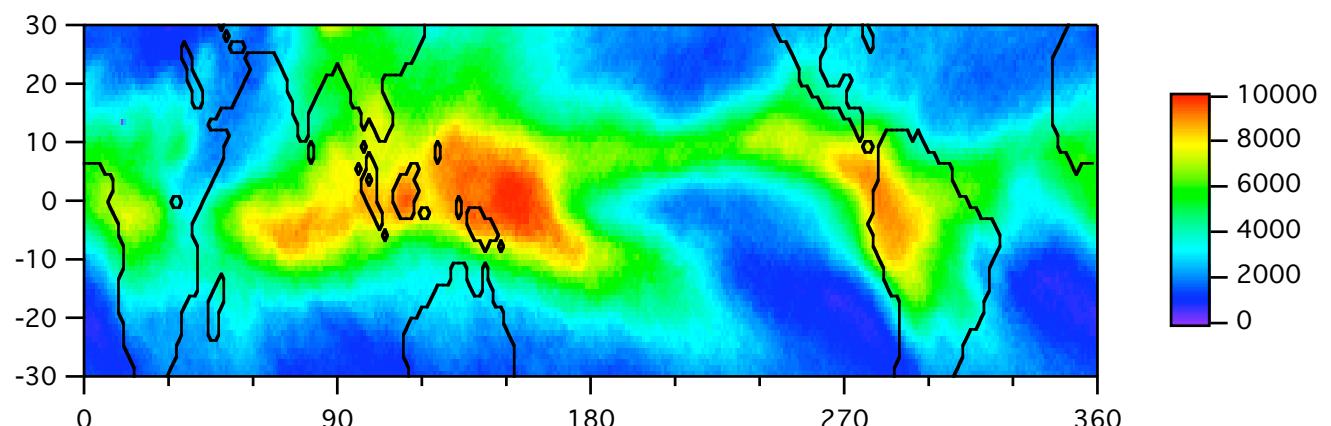
223 hPa



346 hPa

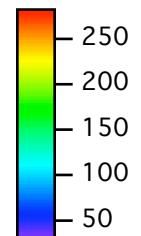
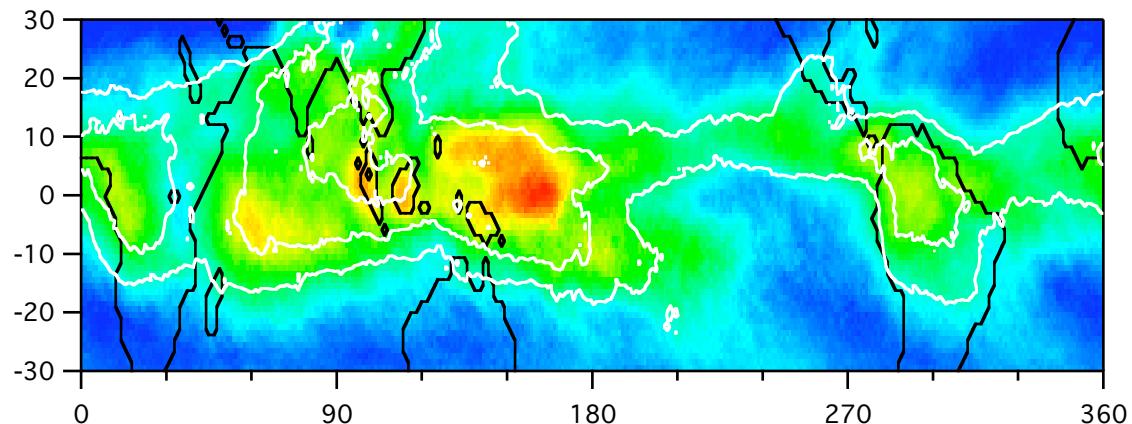


547 hPa

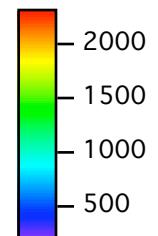
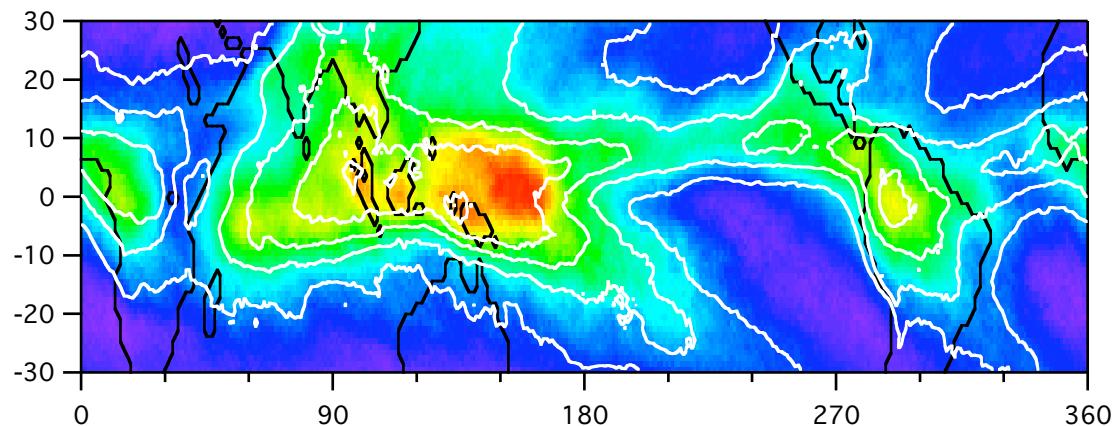


Average:  
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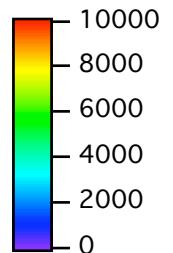
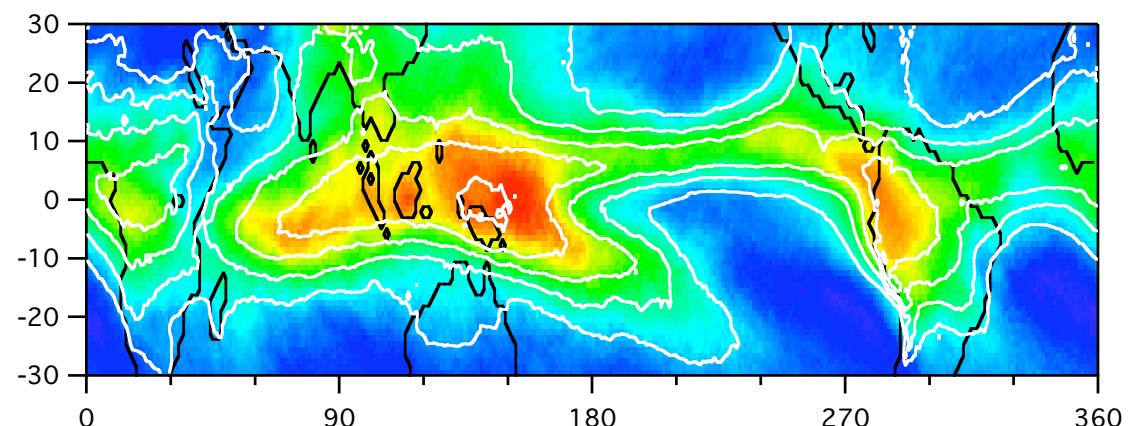
250-200 hPa



400-300 hPa



600-500 hPa

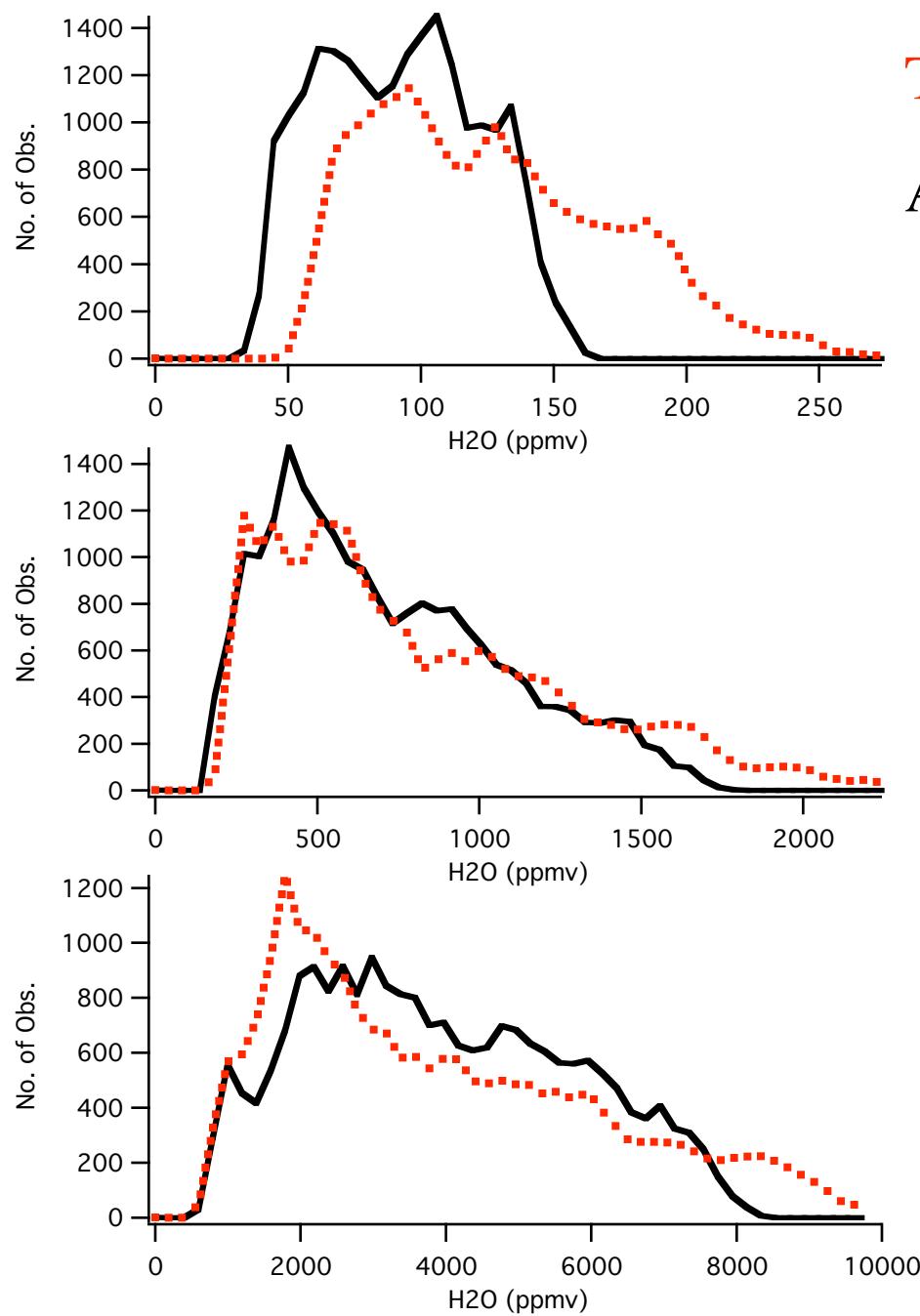


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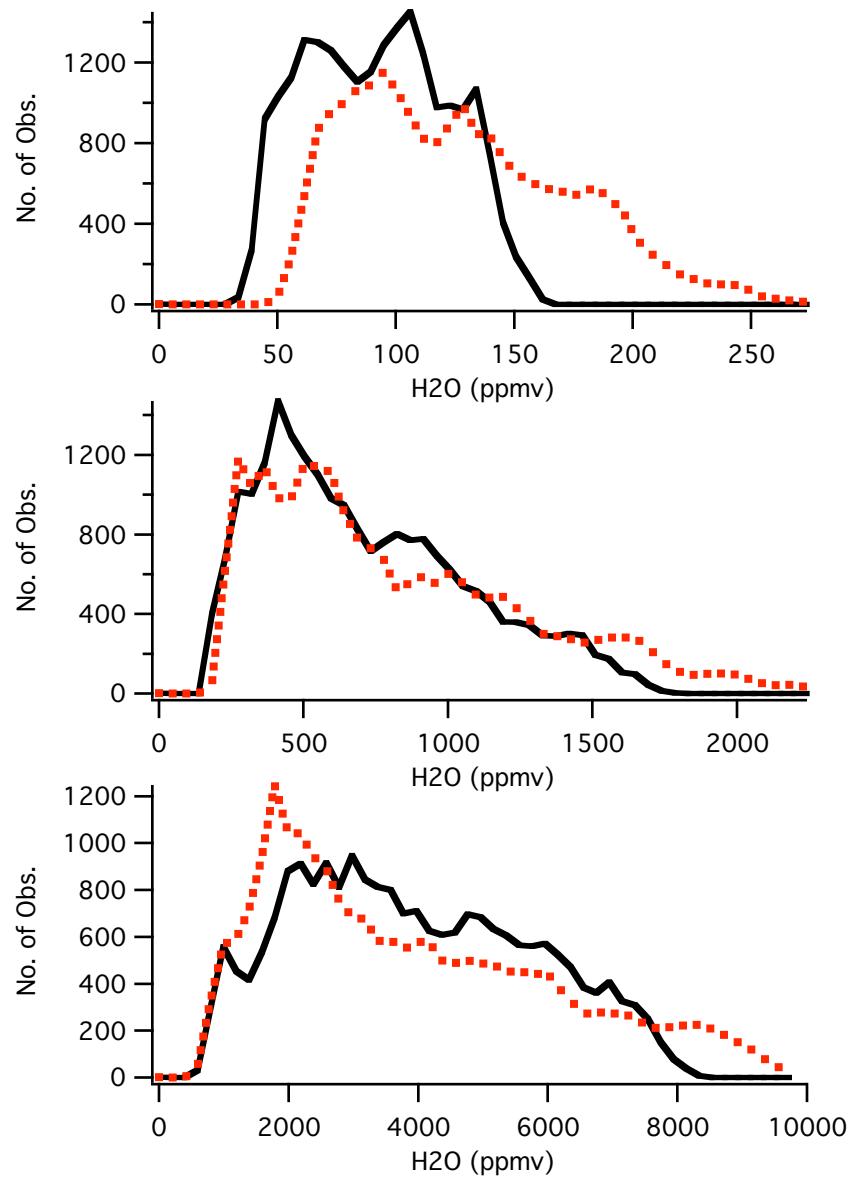
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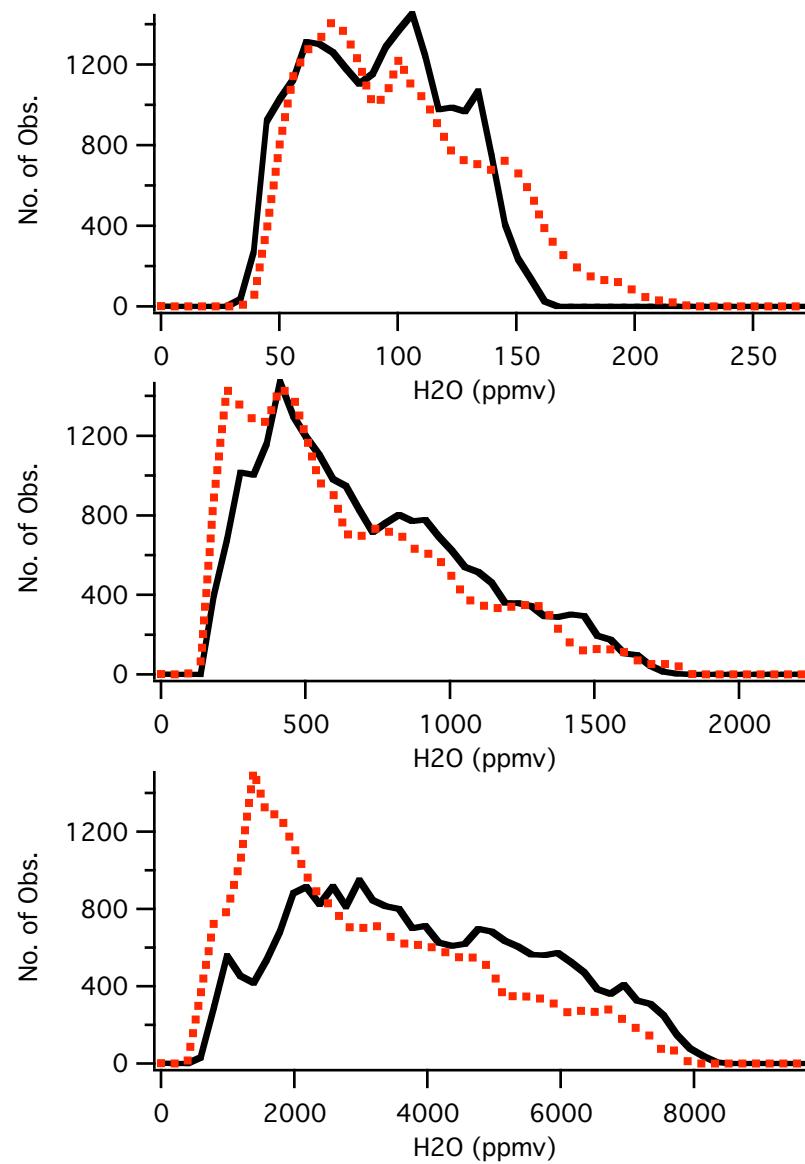
Trajectory  
AIRS



Maximum RH = 100%

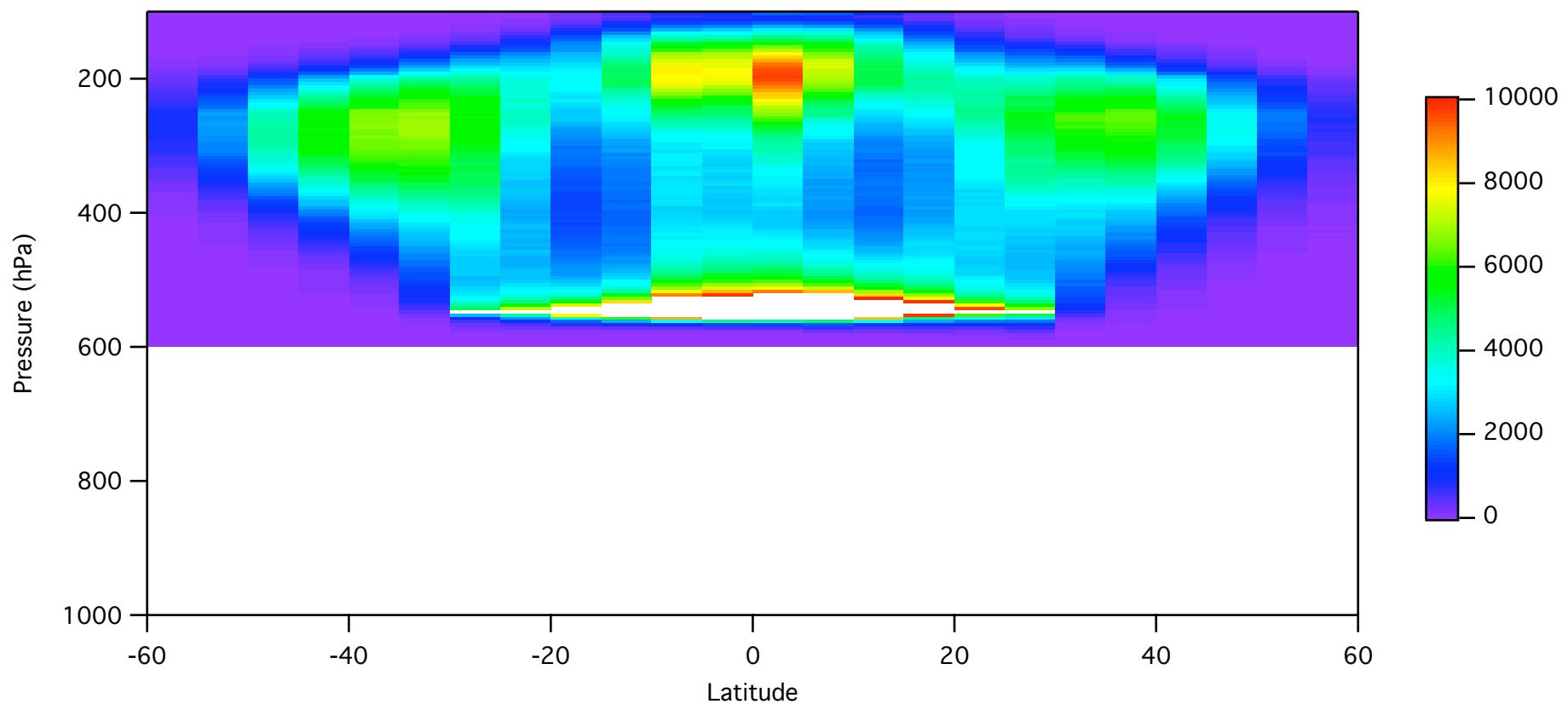


Maximum RH = 80%



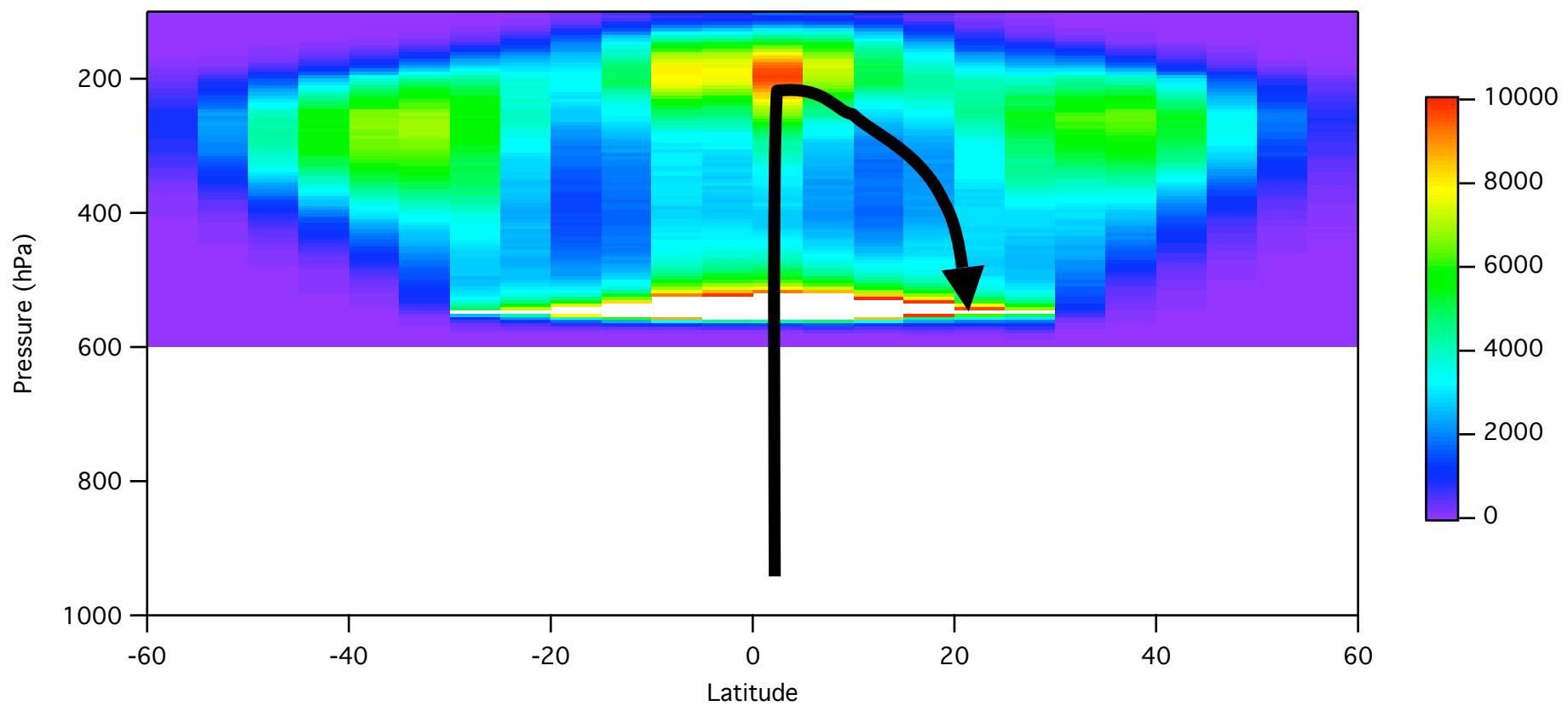
# Potential Temperature Surfaces

## Dehydration locations for parcels that end at 547 hPa

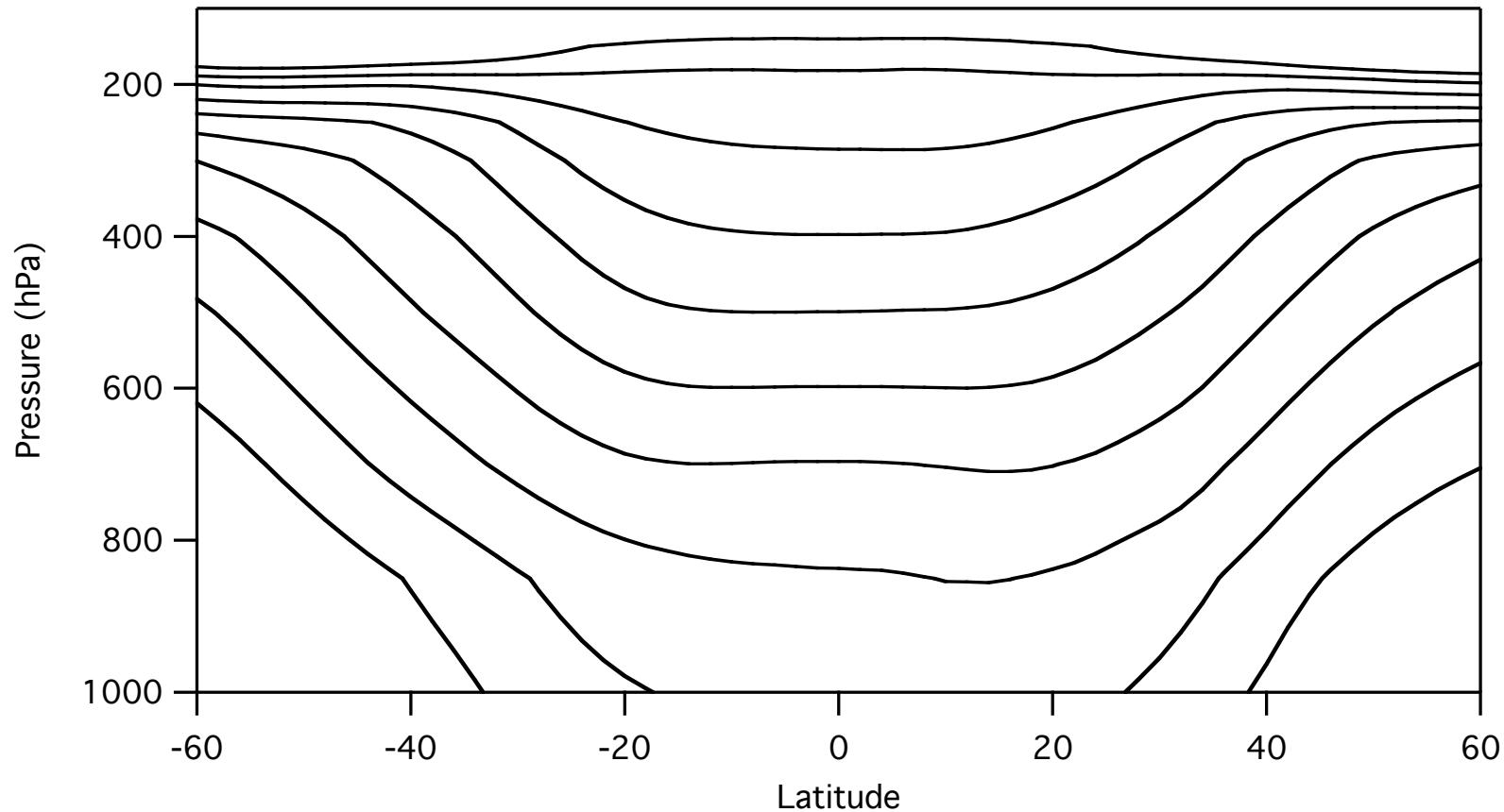


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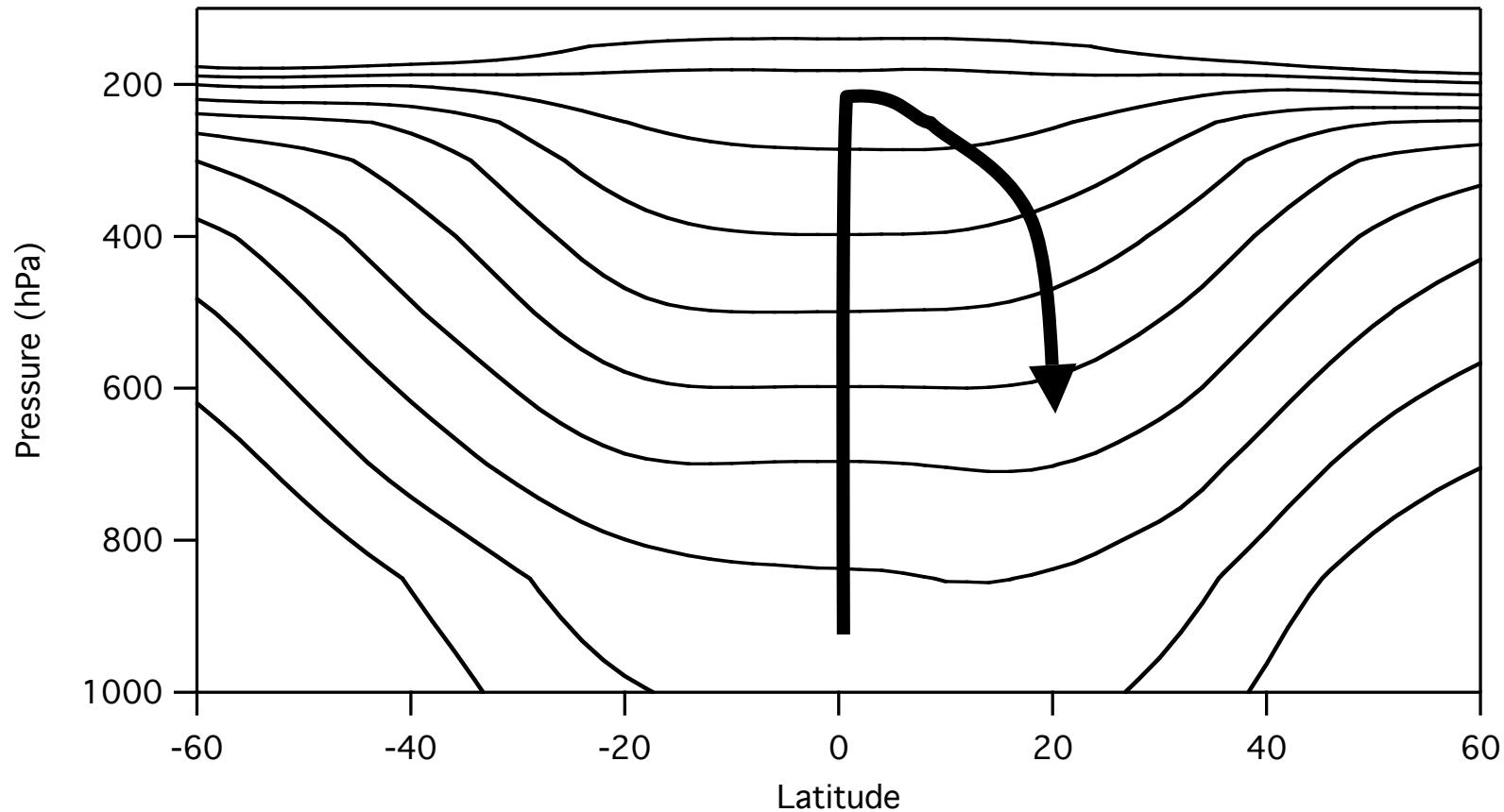


Zonally averaged NCEP data, 3/1/03-2/28/04

See Kelly, Pierrehumbert, Galewsky



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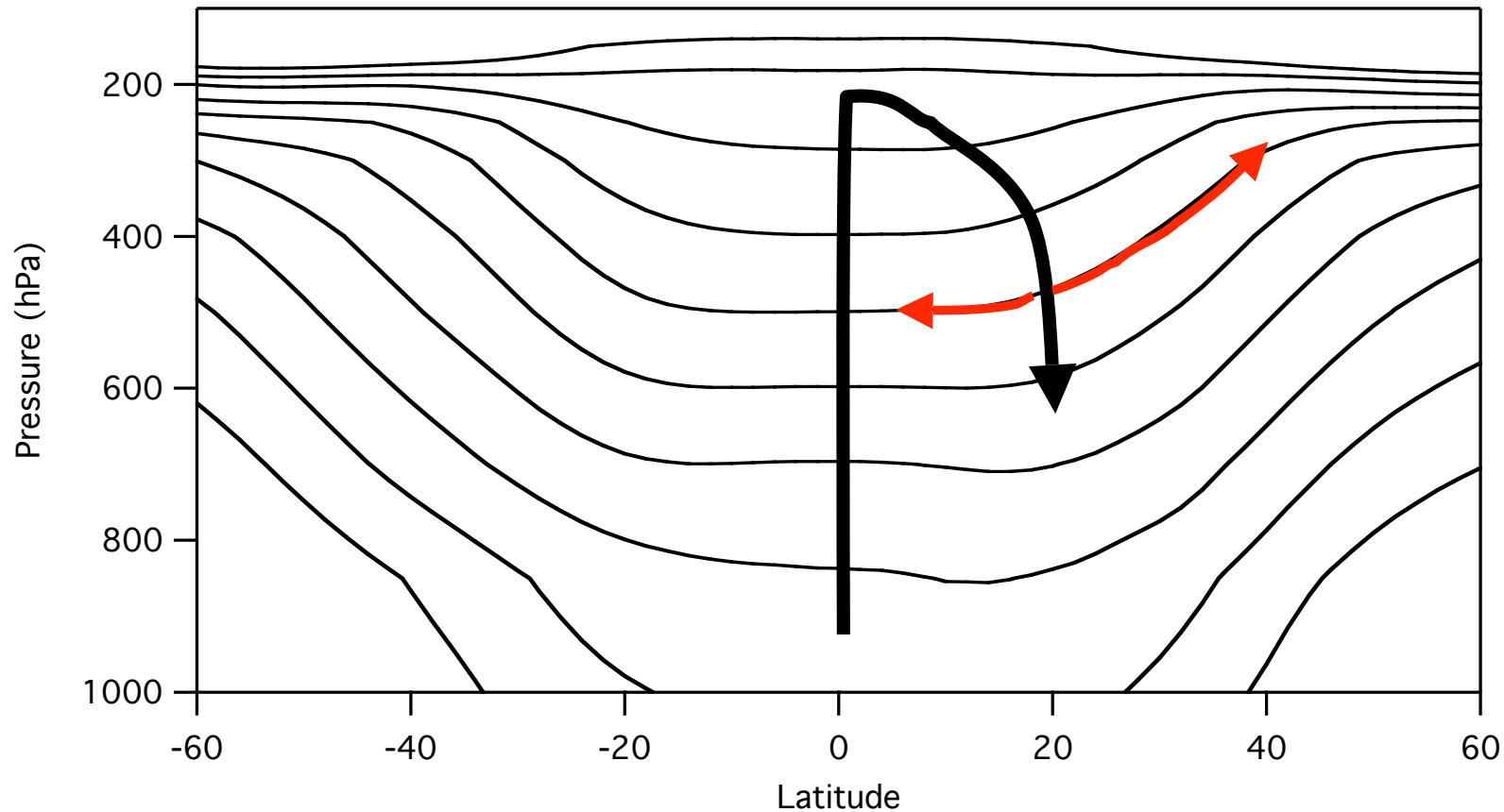


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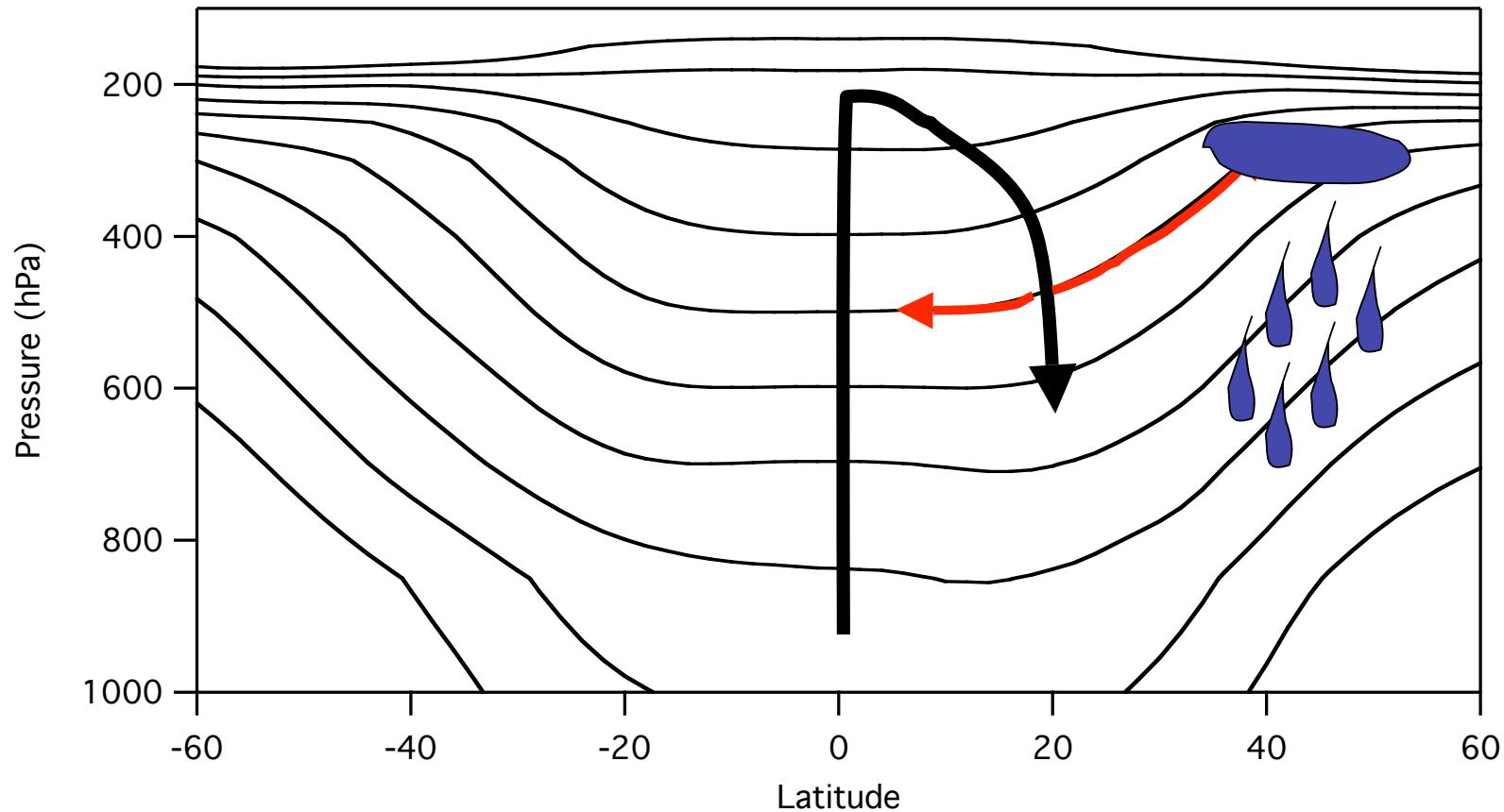


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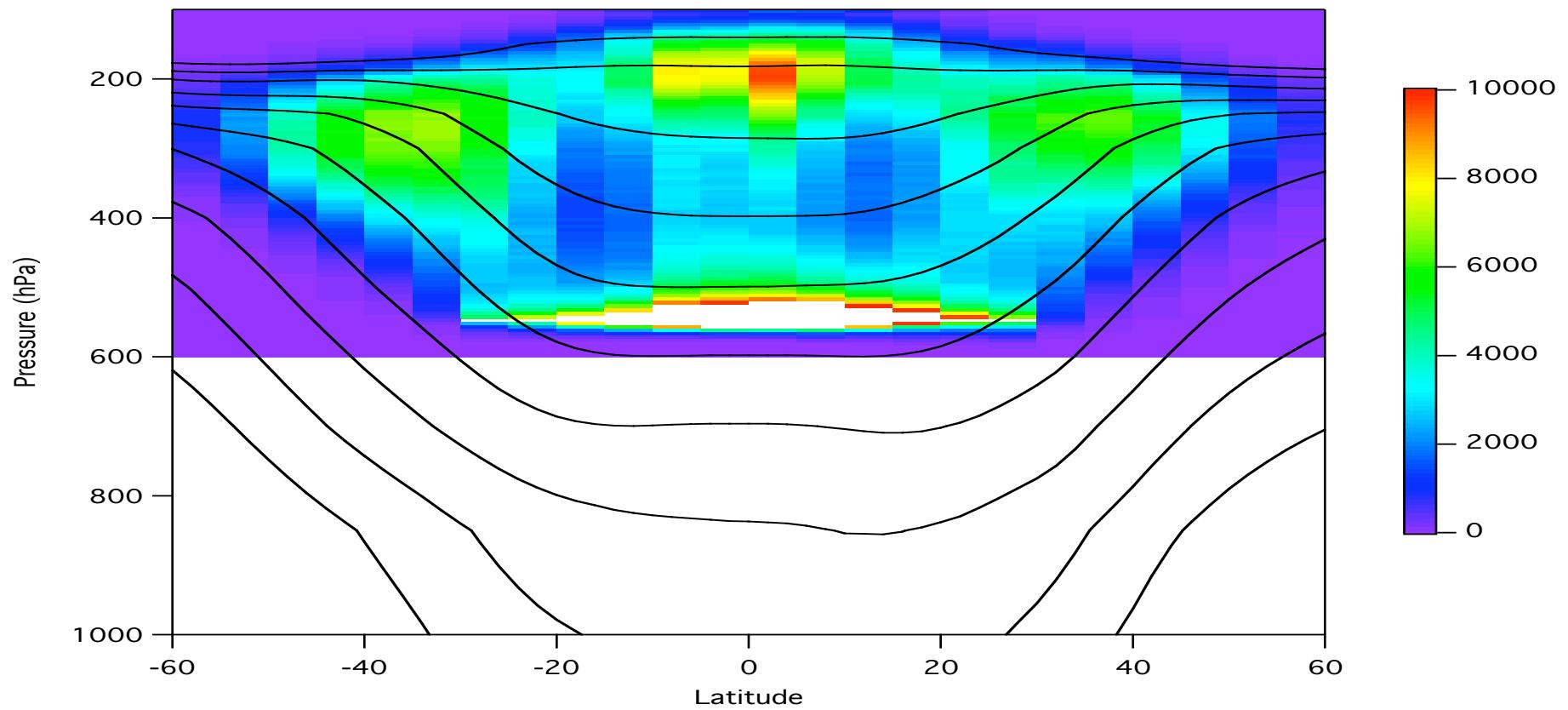
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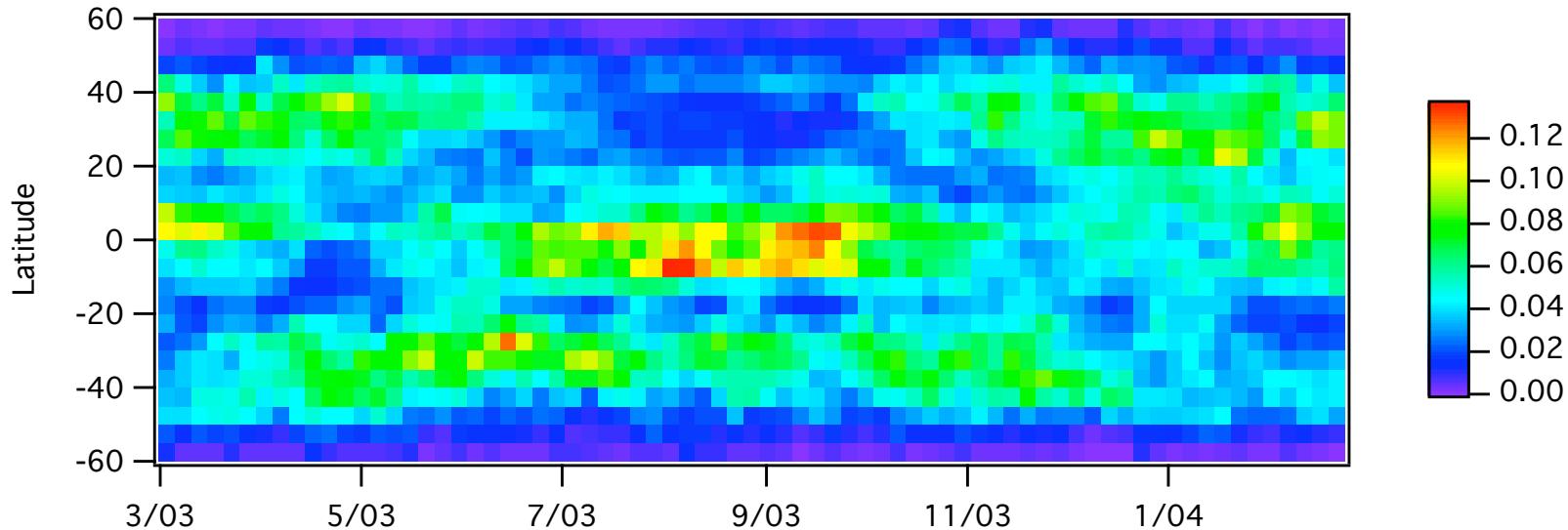
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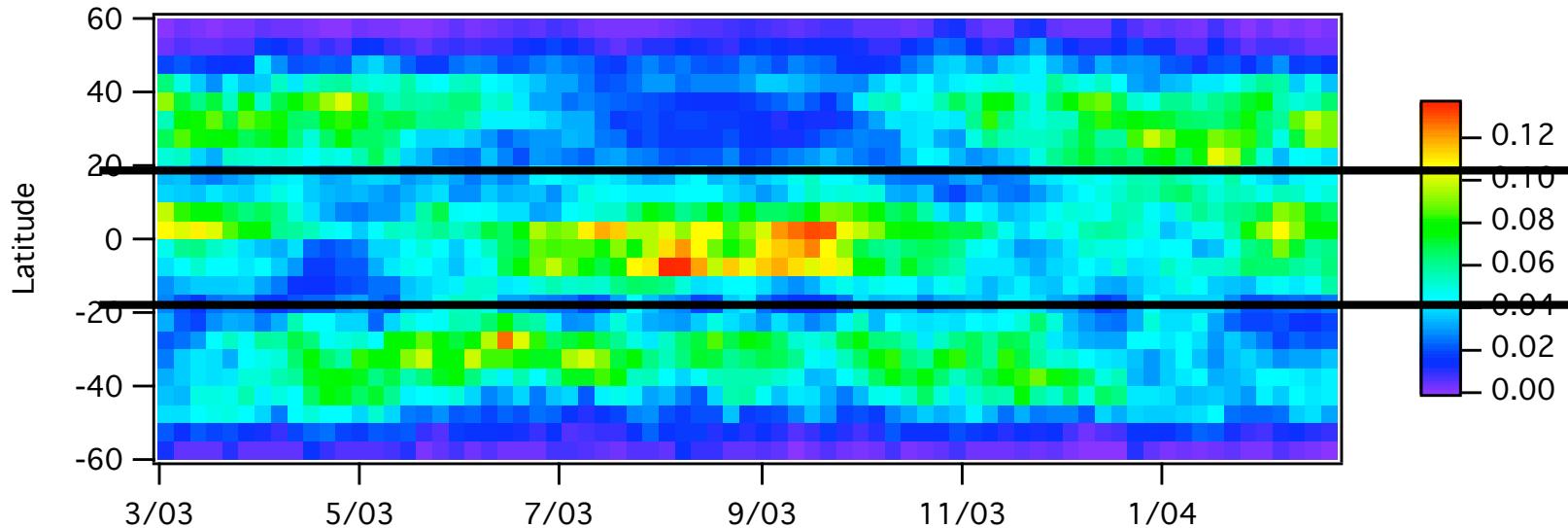




Time-Latitude cross section of dehydration frequency

Includes parcels that saturate at altitudes above 400 hPa

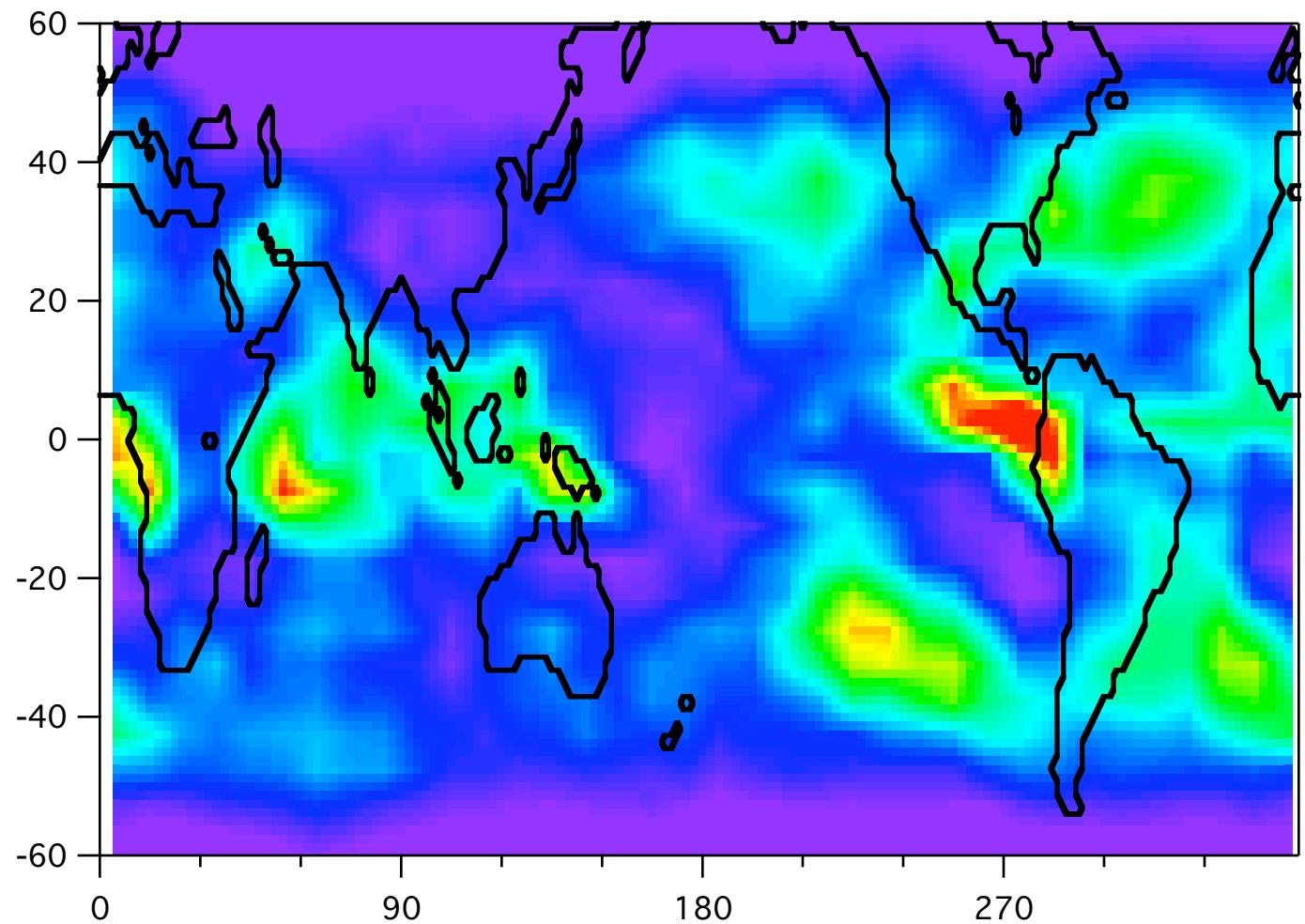




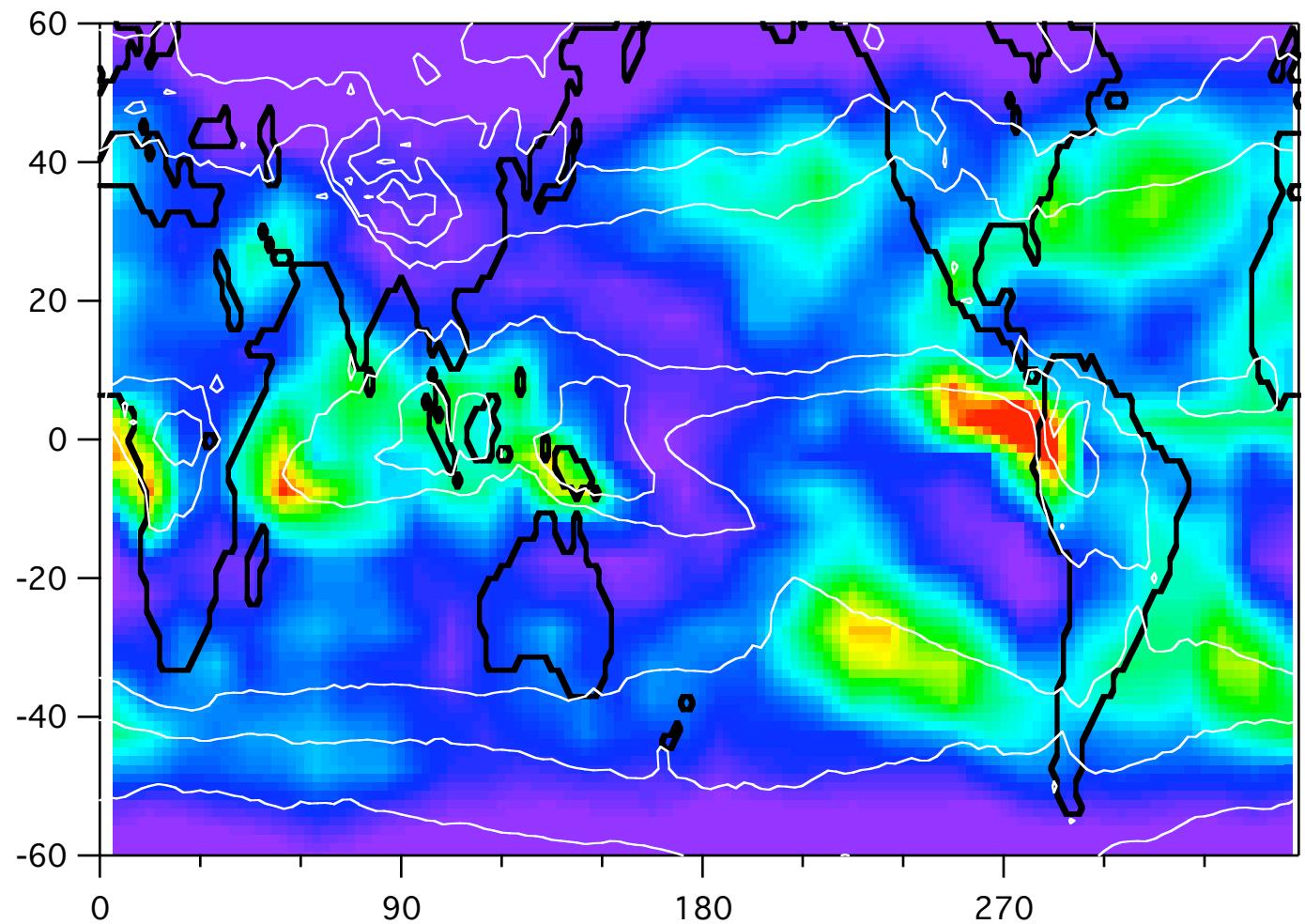
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**ATM**



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# Conclusions

- Simple trajectory model with fixed RH limit does a good job of reproducing AIRS annual average water vapor
  - Some differences exist, particularly at high MRs
  - We see no evidence that subgrid-scale or microphysical processes are critical for accurate simulations
- Model shows that dehydration of mid-troposphere air occurs in three latitude bands
  - Extratropical dehydration occurs during mixing up the isentropes
- Thanks to the AIRS team!!!!



# Future work

- This work --- in preparation
- Minschwaner, Dessler, Sawaengphokhai, Multi-model analysis of the water vapor feedback in the tropical upper troposphere, *J. Clim.*, accepted
- Wong, S., P.R. Colarco, and A.E. Dessler, Principal component analysis of the evolution of the Saharan Air Layer and dust transport: Comparisons between a model simulation and MODIS and AIRS retrievals, *J. Geophys. Res.*, submitted
- Wu, W., A.E. Dessler, G.R. North, On the transport of surface temperature variations into the free troposphere, *Geophys. Res. Lett.*, in preparation.

